

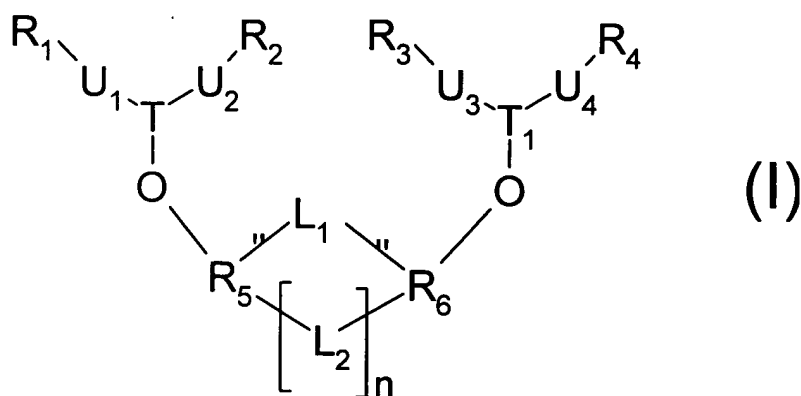
AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1-24 (Canceled)

25. (New) A process for hydrocyanating a hydrocarbon compound containing at least one ethylenic unsaturation by reacting it in a liquid medium with hydrogen cyanide in the presence of a catalyst comprising a metallic element selected from transition metals and an organic ligand, wherein the organic ligand corresponds to the general formula I below:



in which:

T and T₁, which are identical or different, represent a phosphorus, arsenic or antimony atom,

R₁, R₂, R₃ and R₄, which are identical or different, represent a substituted or unsubstituted, aromatic, aliphatic or cycloaliphatic radical having one or more rings,

which are in fused form or not, optionally having one or more heteroatoms, wherein the radicals R_1 and R_2 on the one hand and R_3 and R_4 on the other hand are optionally interconnected by a covalent bond, a hydrocarbon chain or a heteroatom,

U_1 , U_2 , U_3 and U_4 , which are identical or different, represent an oxygen atom or a radical of formula NR in which R denotes a monovalent alkyl, aryl, cycloalkyl, sulphonyl or carbonyl radical,

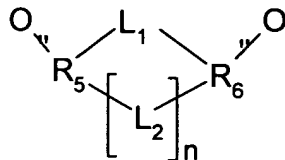
R_5 and R_6 , which are identical or different, represent an aryl or cycloaliphatic group optionally having heteroatoms and/or one or more rings, in fused form or not, and which are substituted or unsubstituted,

n is an integer equal to 0 or 1,

L_1 , when n is 0, represents a divalent radical selected from the group consisting of the groups NR_7 , PR_8 , SiR_9R_{10} , BR_{11} , S , POR_{12} , SO_2 and CO , in which R_7 is as defined for R above, R_8 and R_{12} optionally represent the radical OR_{13} , and R_8 , R_9 , R_{10} , R_{11} , R_{12} and R_{13} represent alkyl, aryl or cycloalkyl radicals,

L_1 and L_2 , when n is 1, are identical or different and represent a covalent bond or a radical selected from the group consisting of the groups O , NR_7 , PR_8 , SiR_9R_{10} , BR_{11} , S , POR_{12} , SO_2 , CO and $-CR_{14}R_{15}-$, in which R_7 is as defined for R above, R_8 and R_{12} optionally represent the radical OR_{13} , and R_8 , R_9 , R_{10} , R_{11} , R_{12} , R_{13} , R_{14} and R_{15} represent alkyl, aryl or cycloalkyl radicals, it being possible also for R_{14} and R_{15} to represent a hydrogen atom.

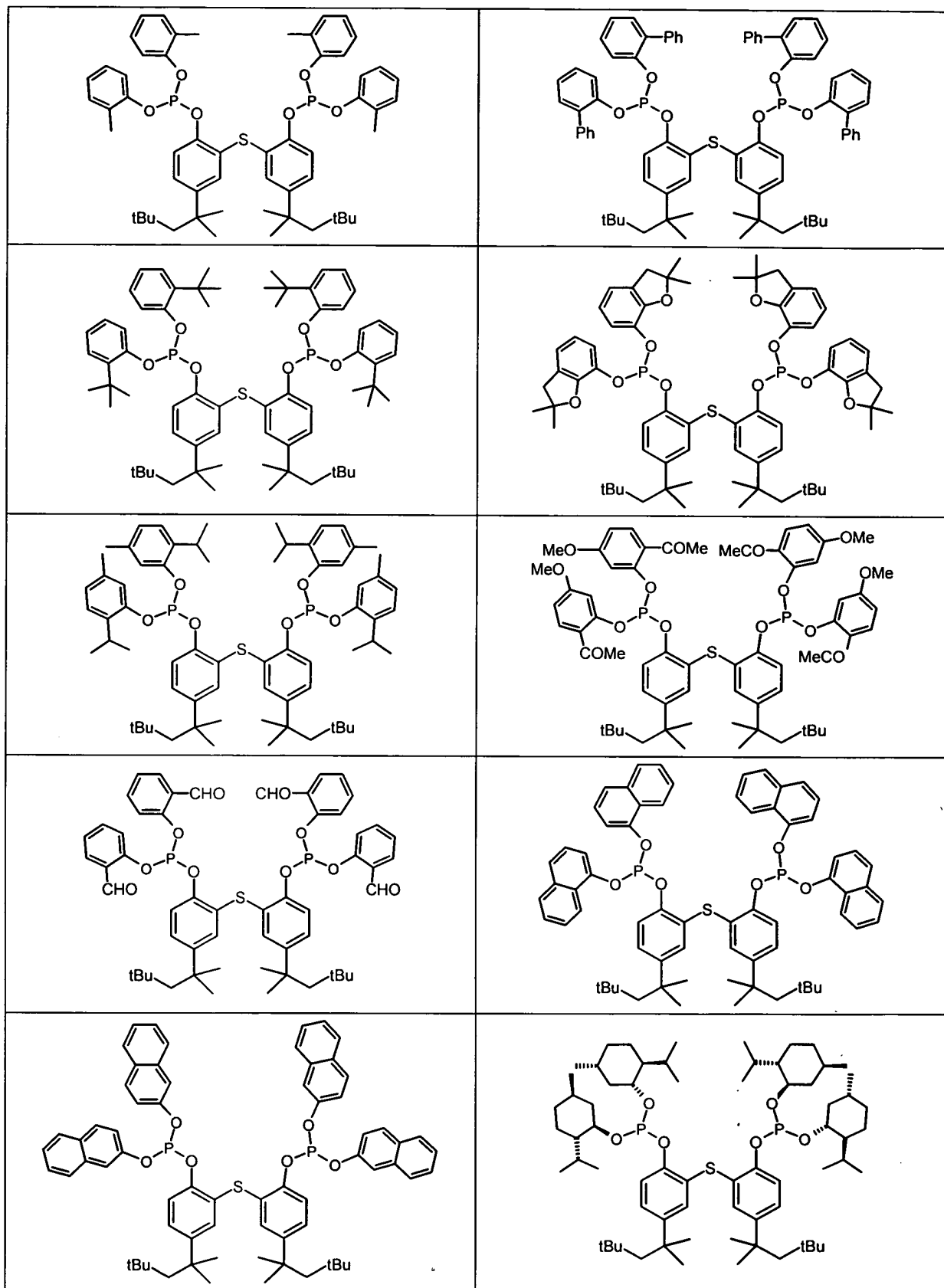
26. (New) The process according to Claim 25, wherein the organic ligand of general formula I presents a structure:

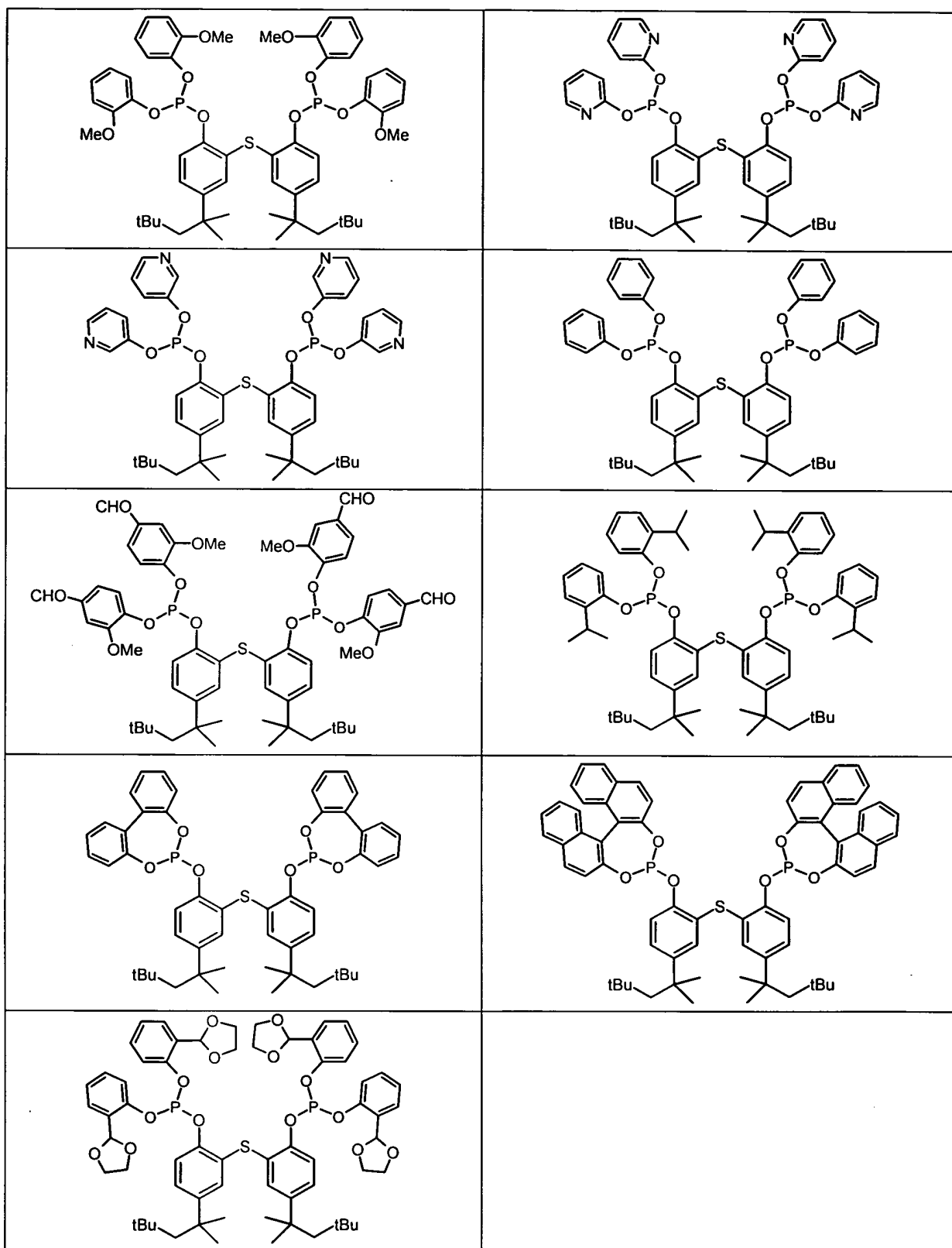


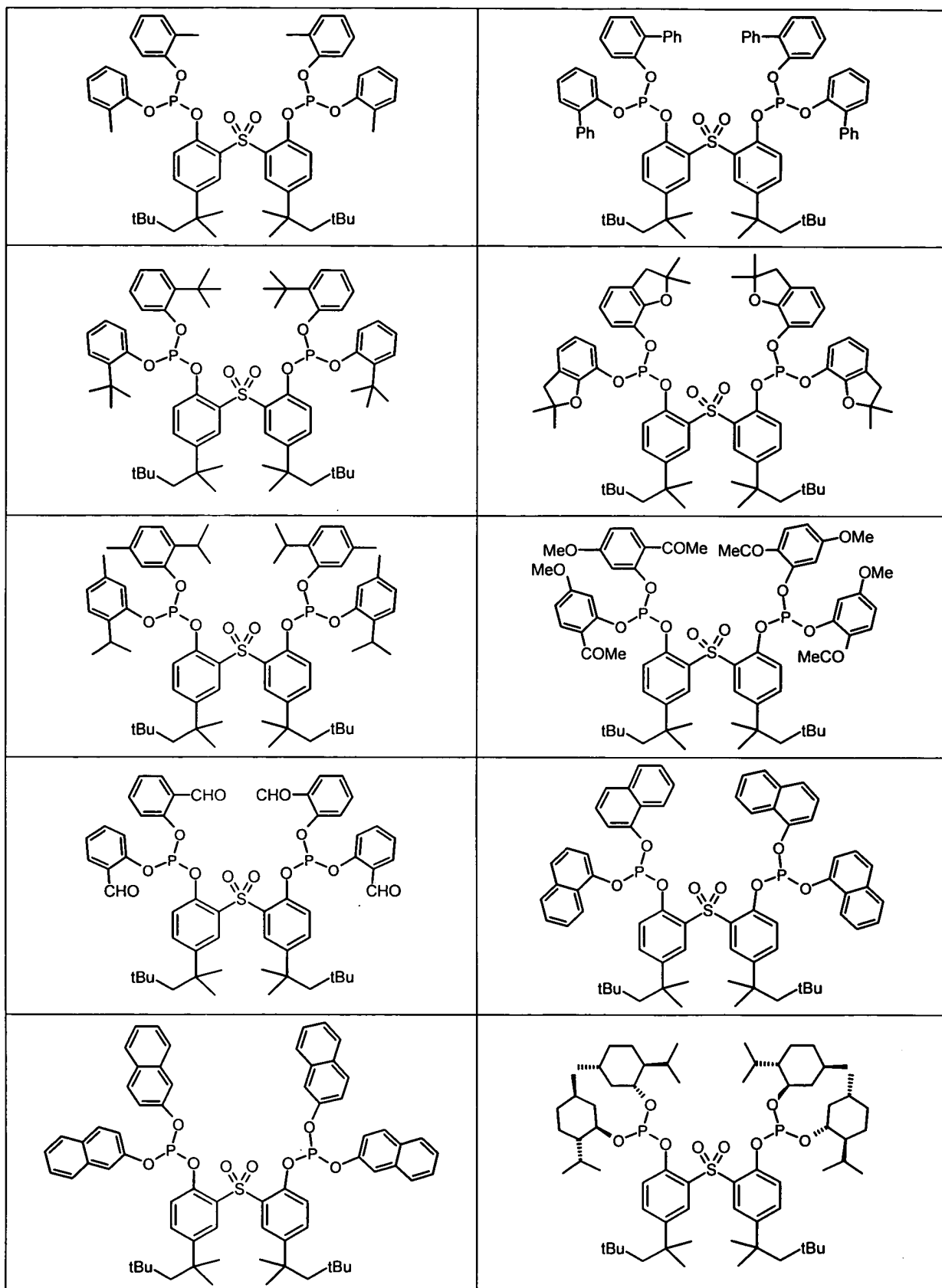
selected from the group consisting of the following structures:

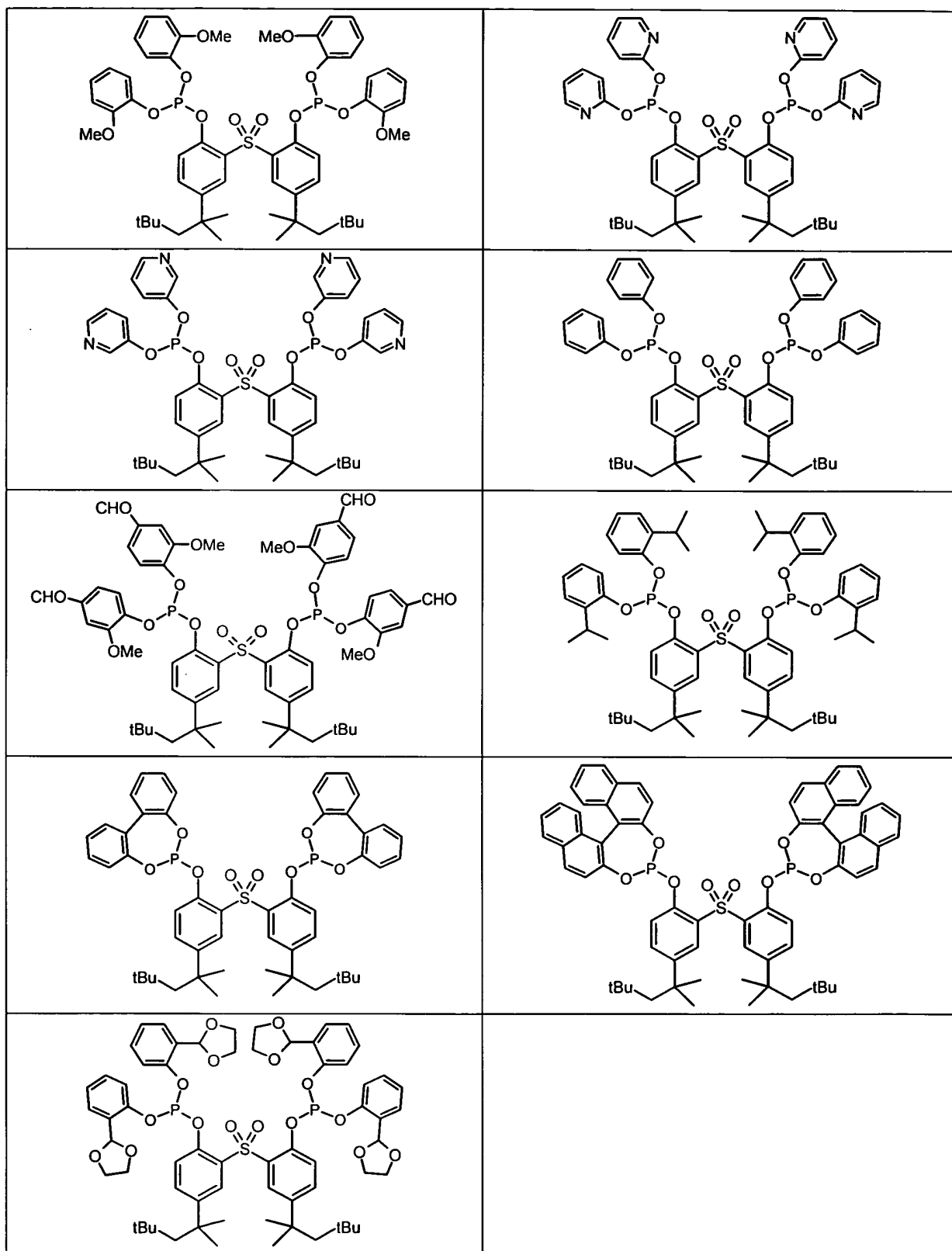
in which R₁₇ represents an alkyl, aryl, halogen, alkoxy, thiol, cyano, nitro, aryloxy, alkoxy carbonyl, acyl or formyl radical.

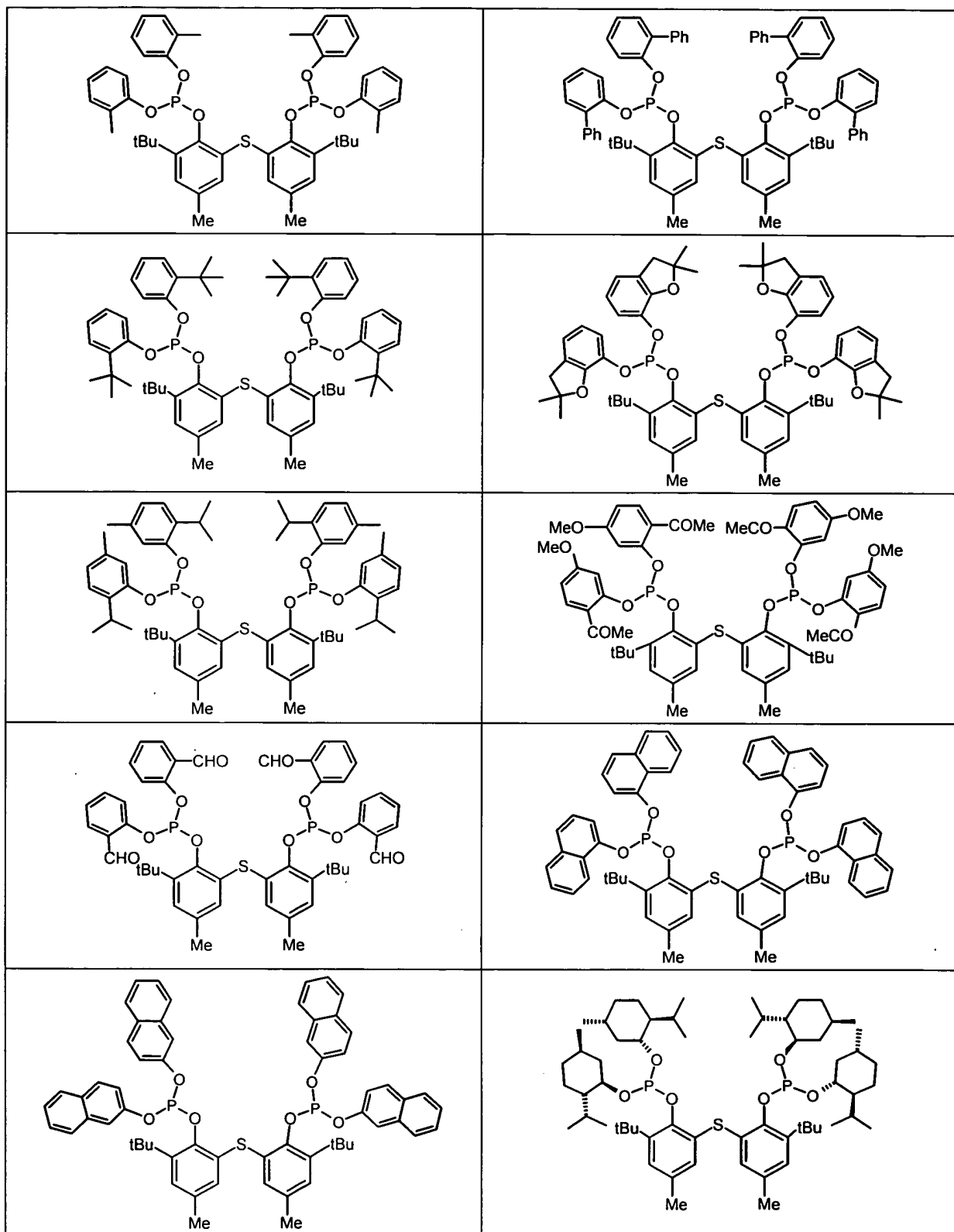
27. (New) The process according to Claim 25, wherein the organic ligand of formula I is selected from the group consisting of:

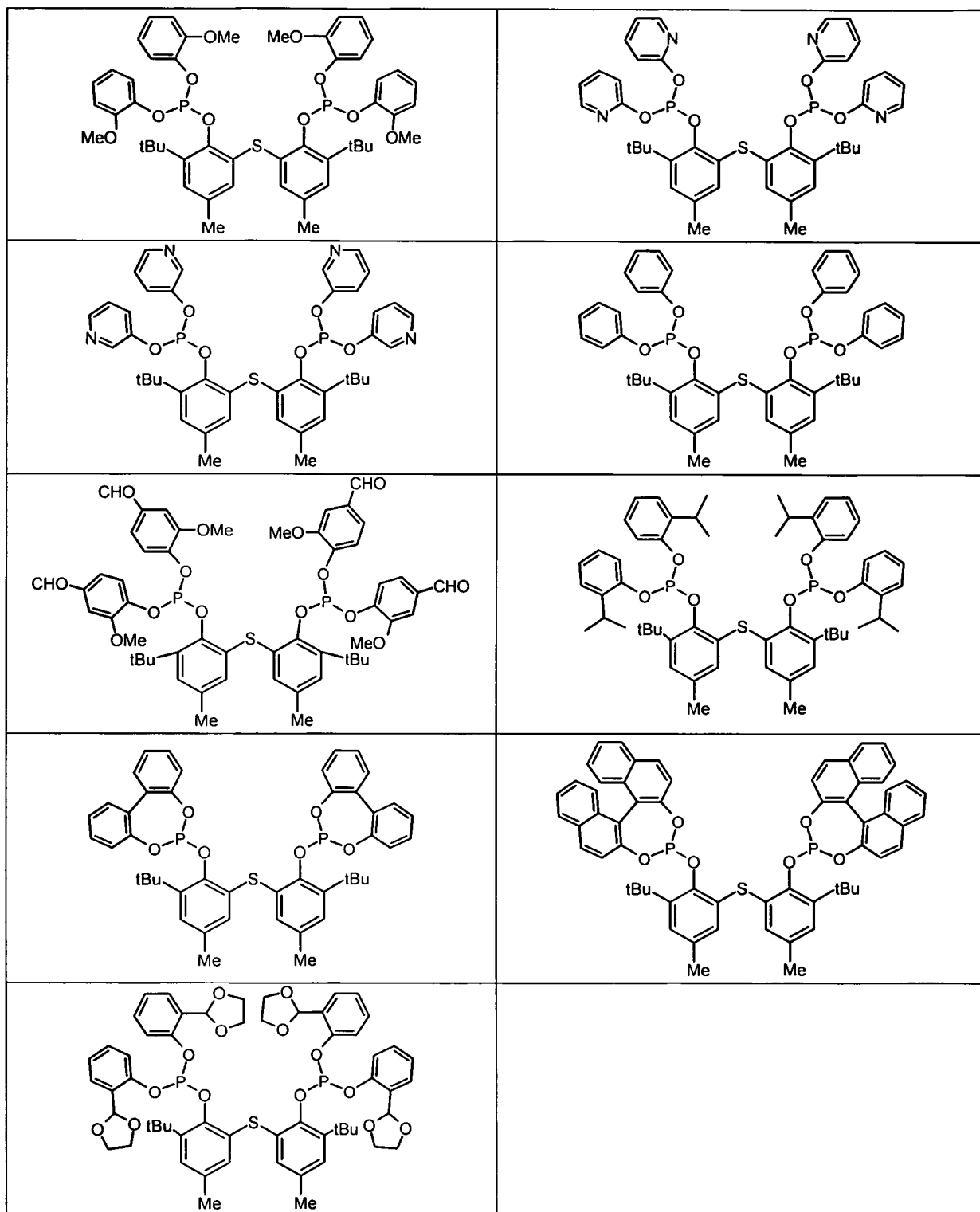


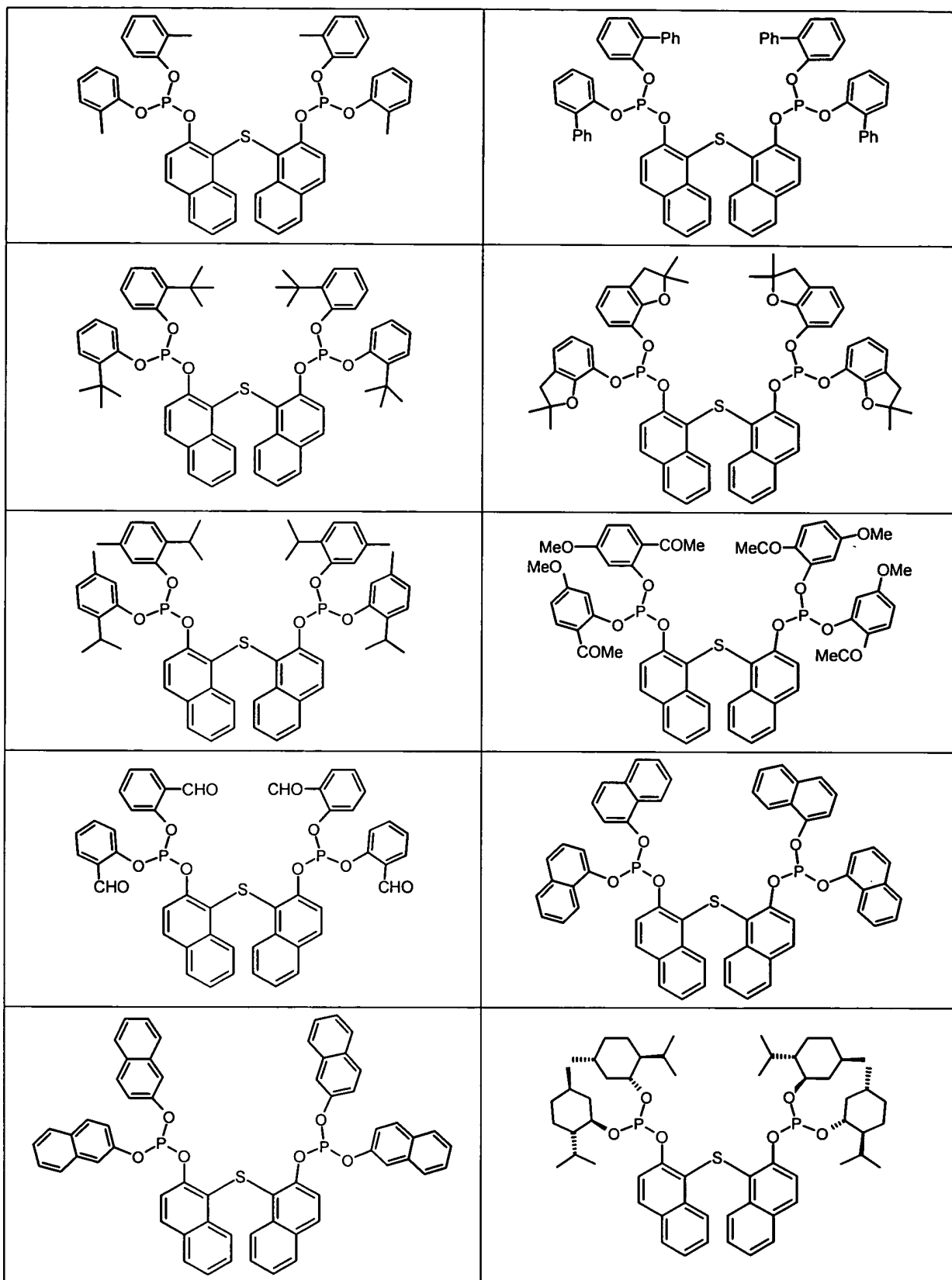


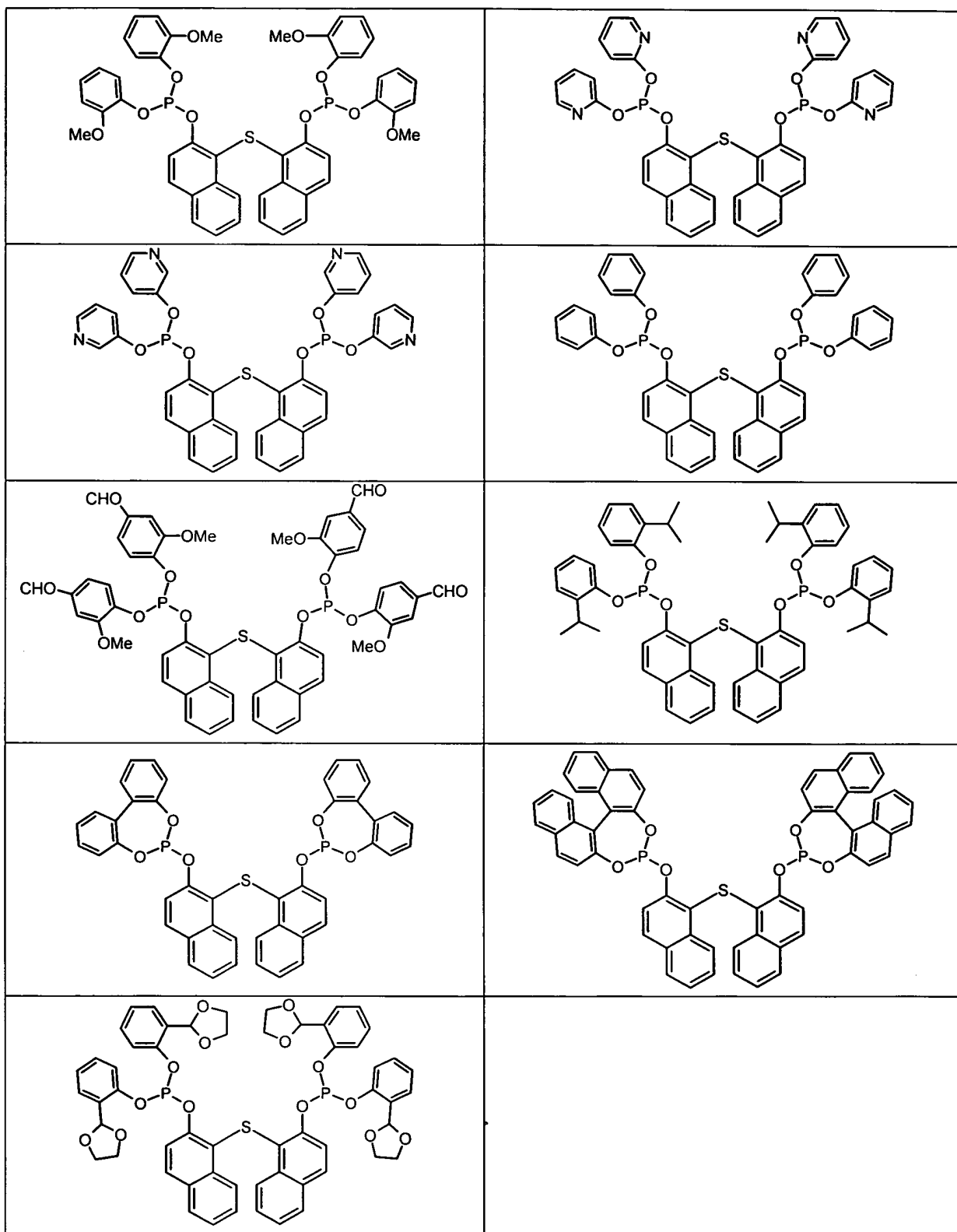


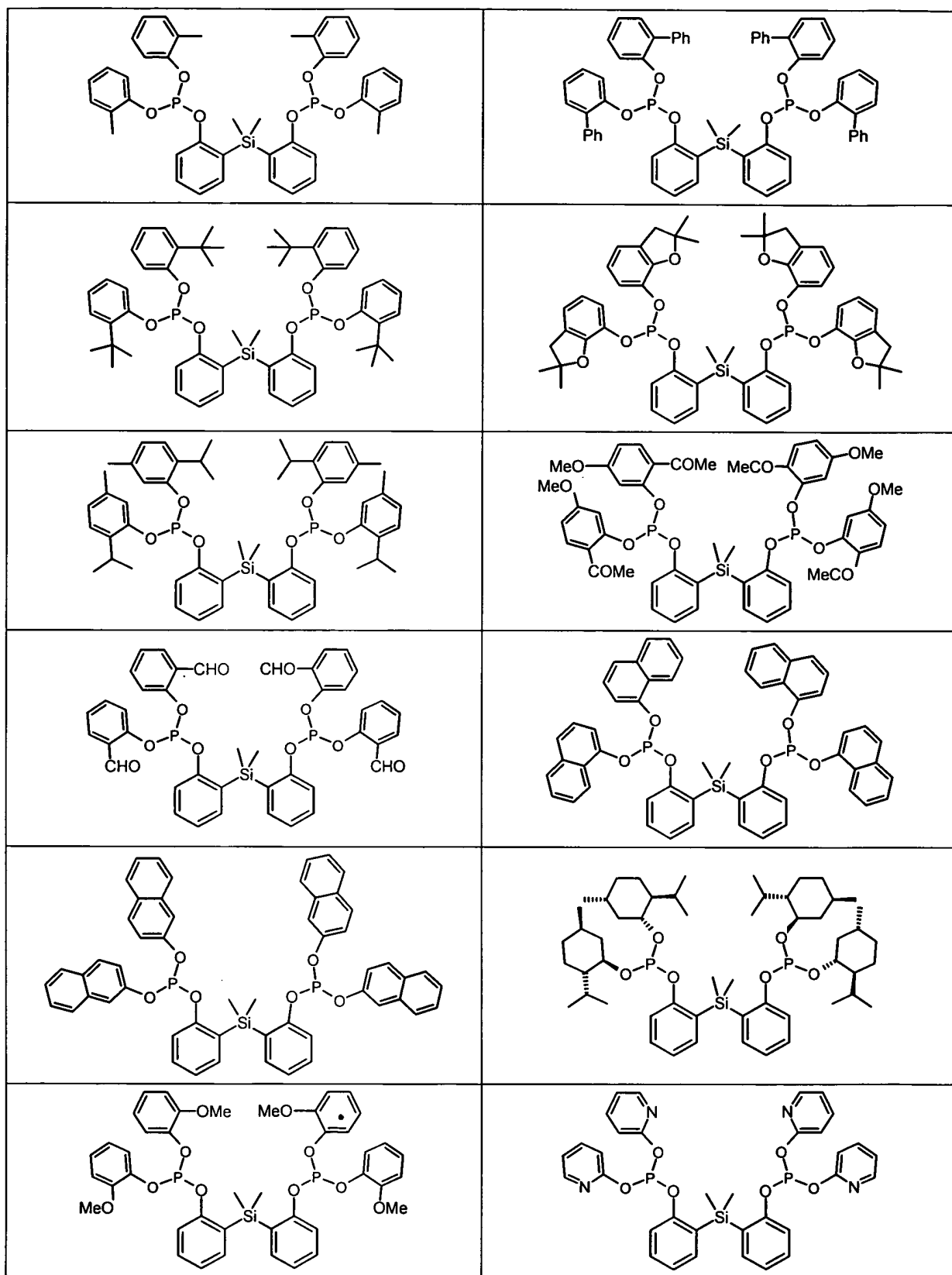


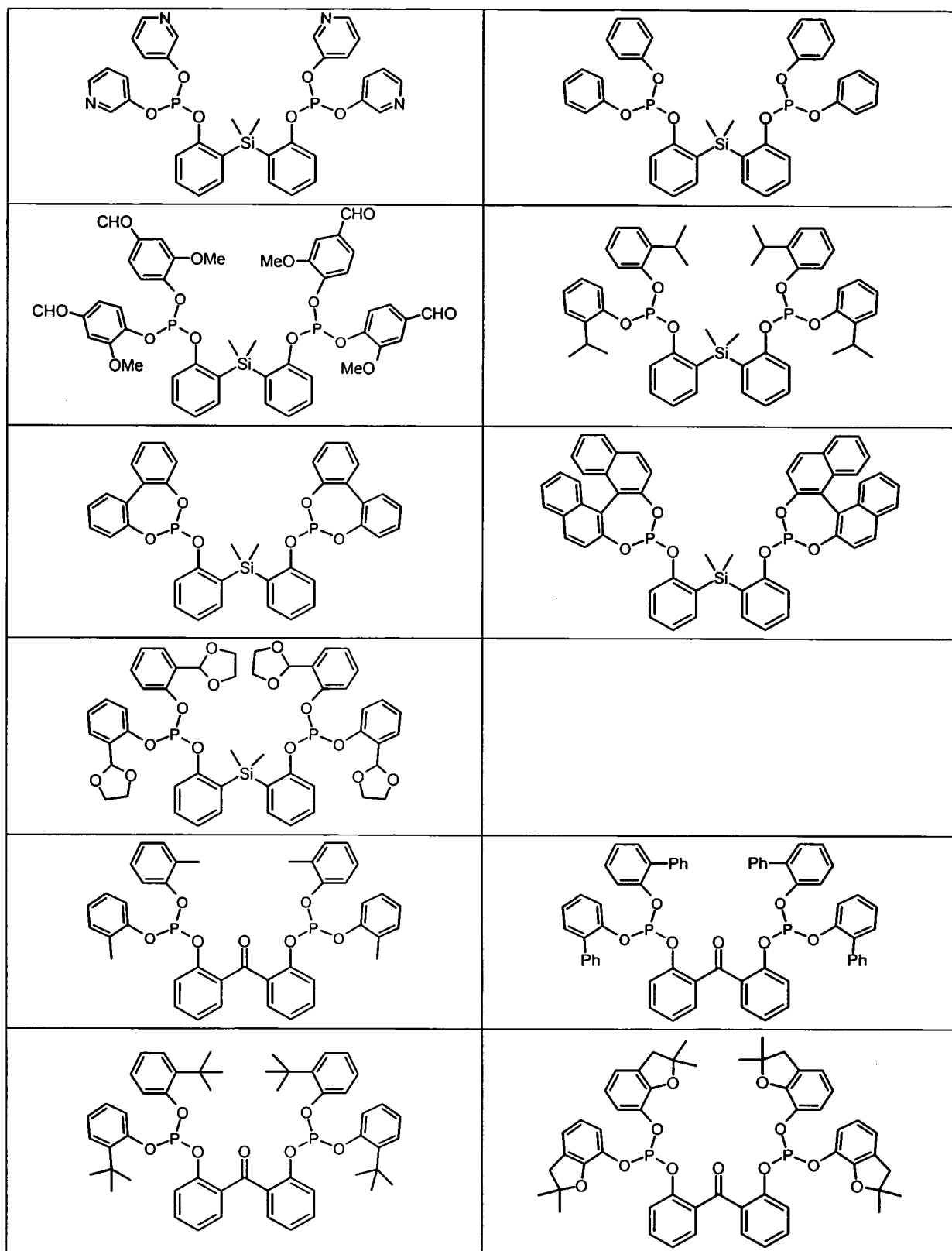


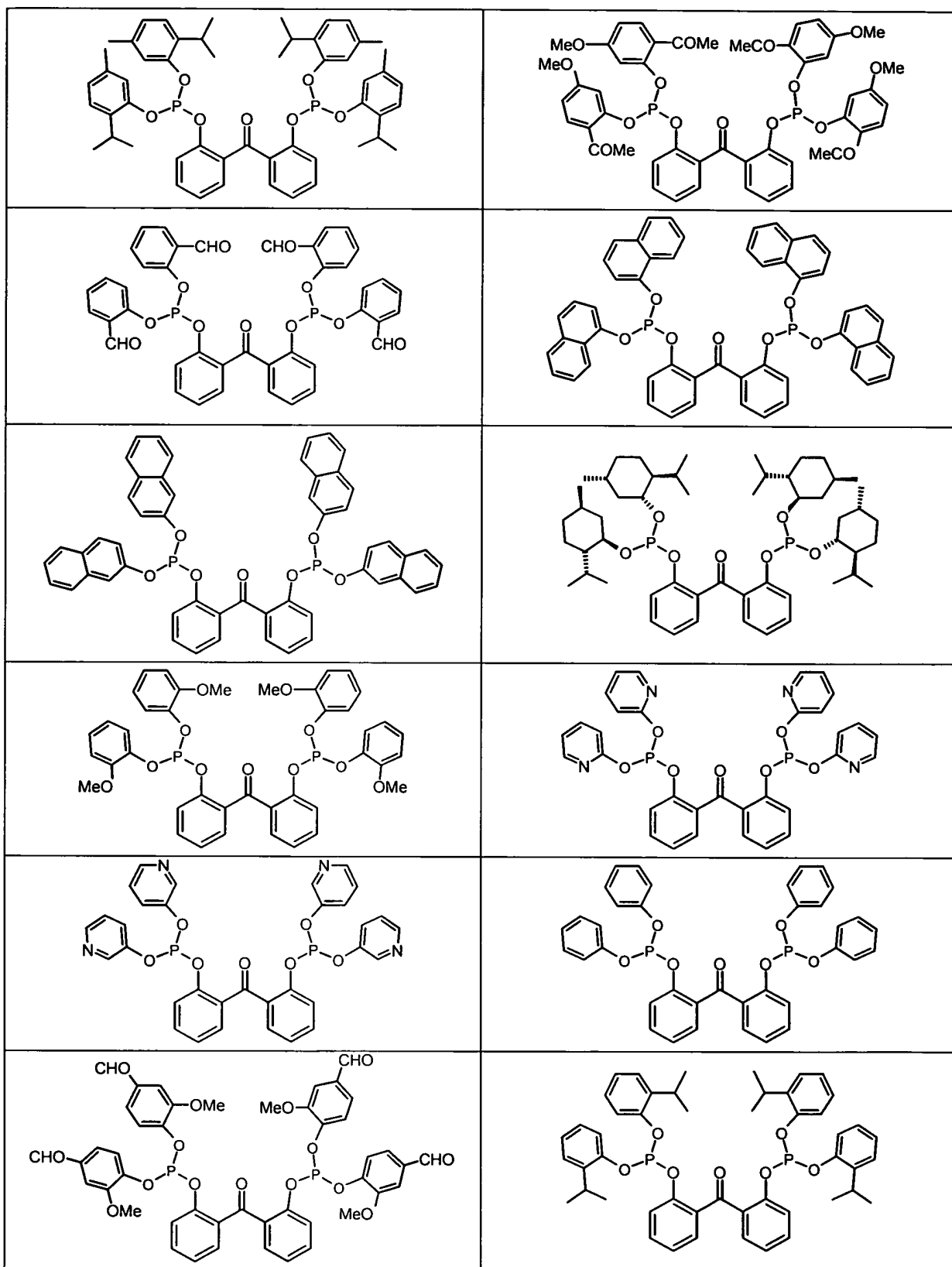


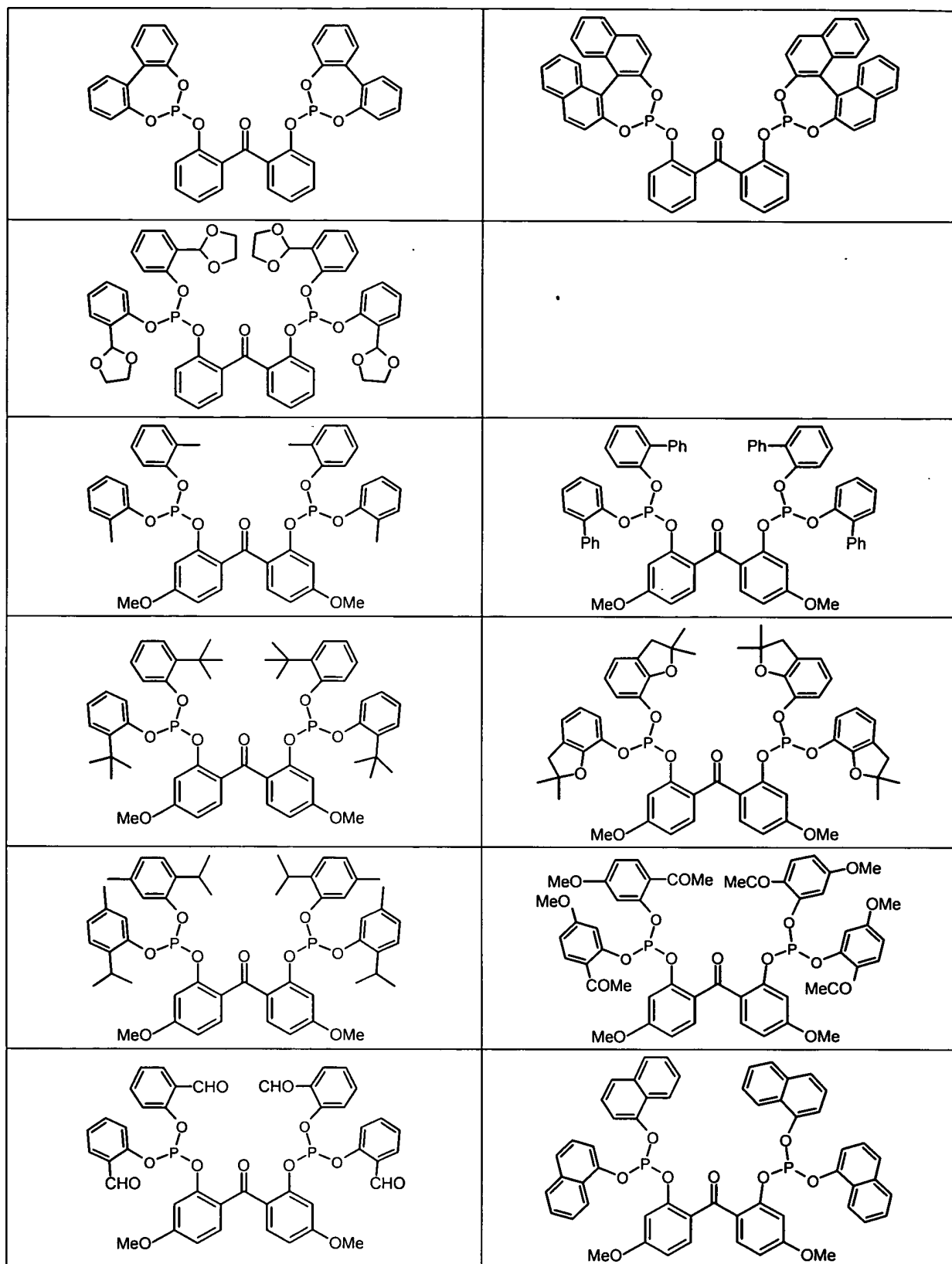


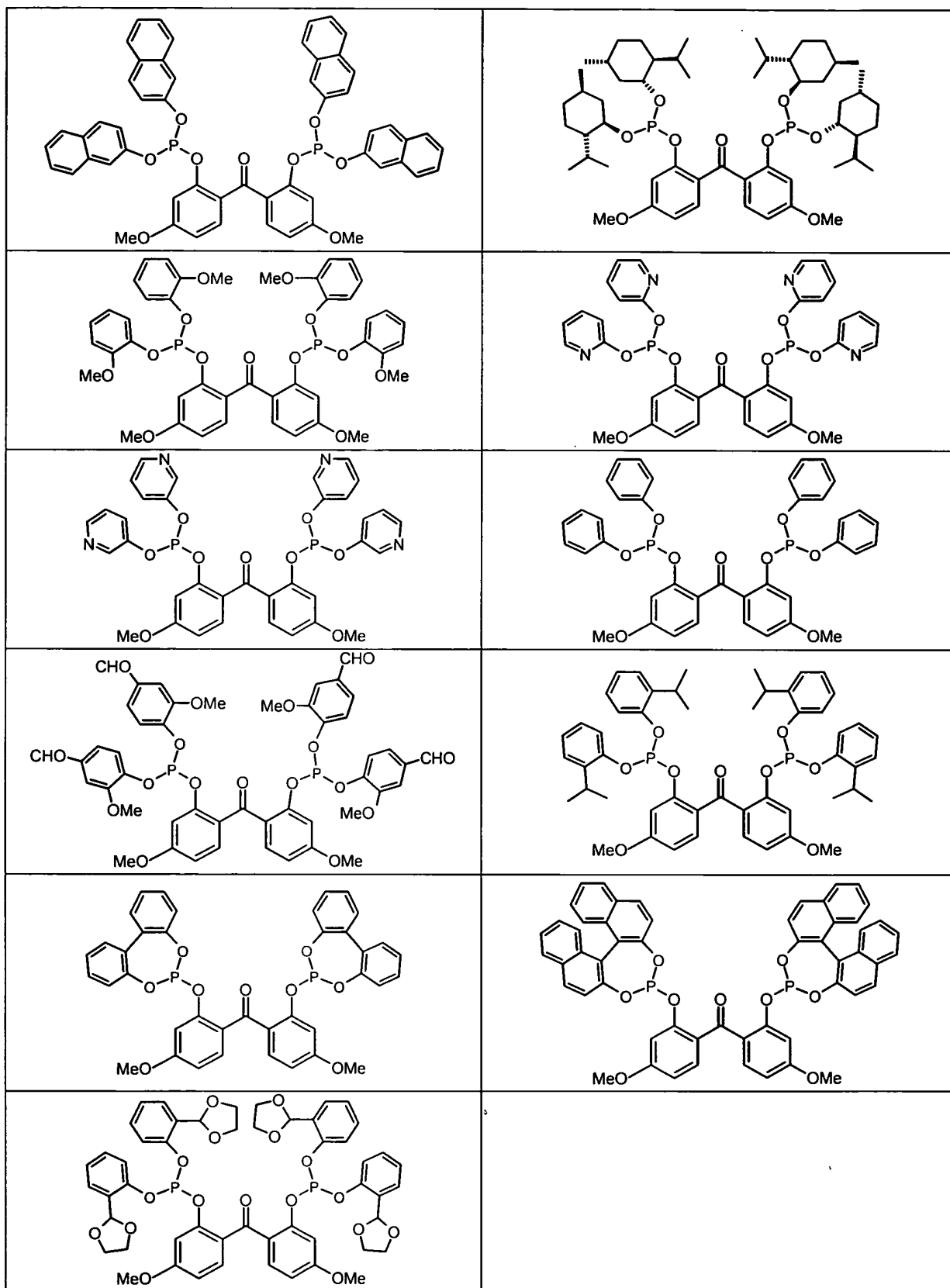


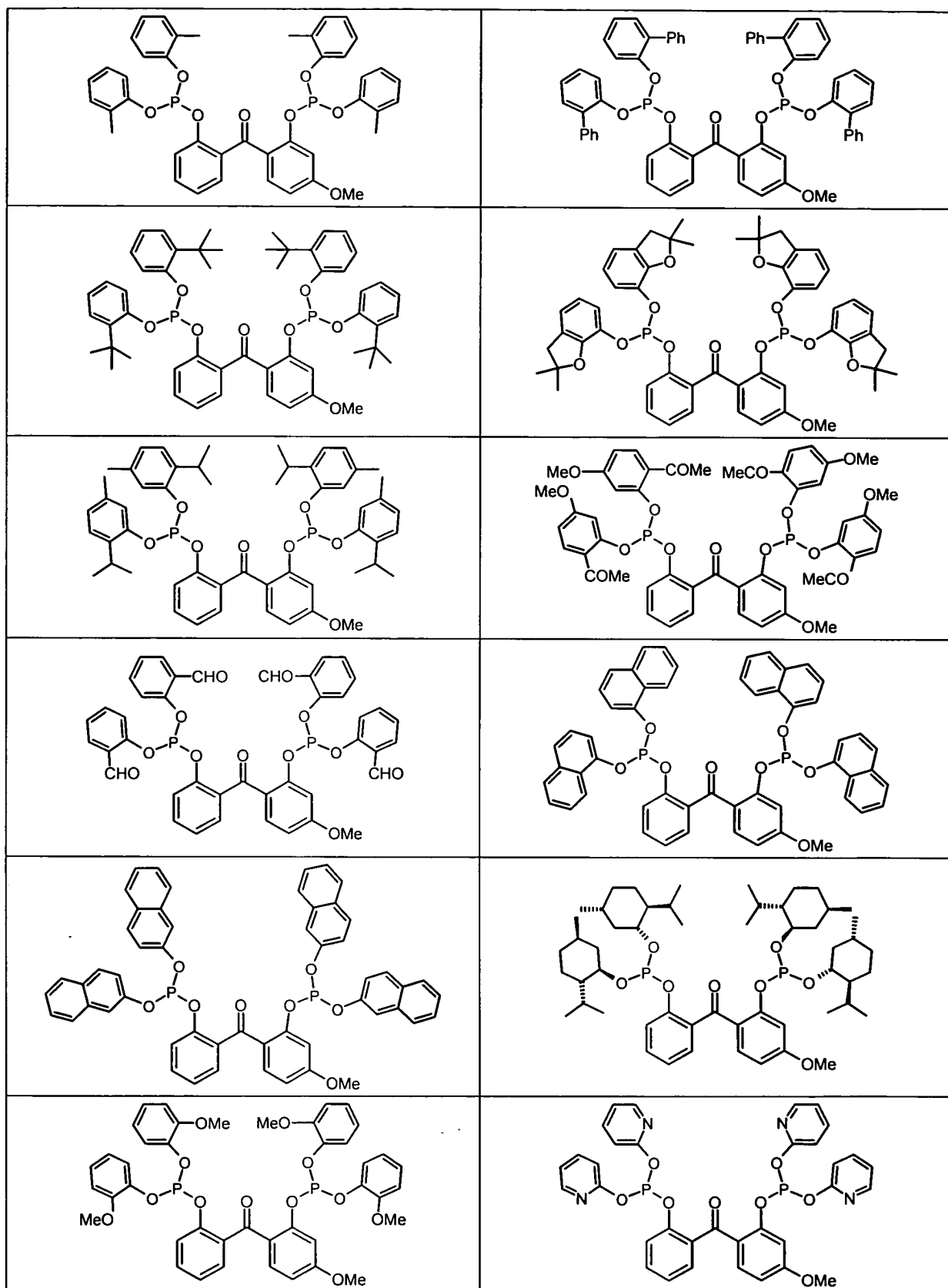


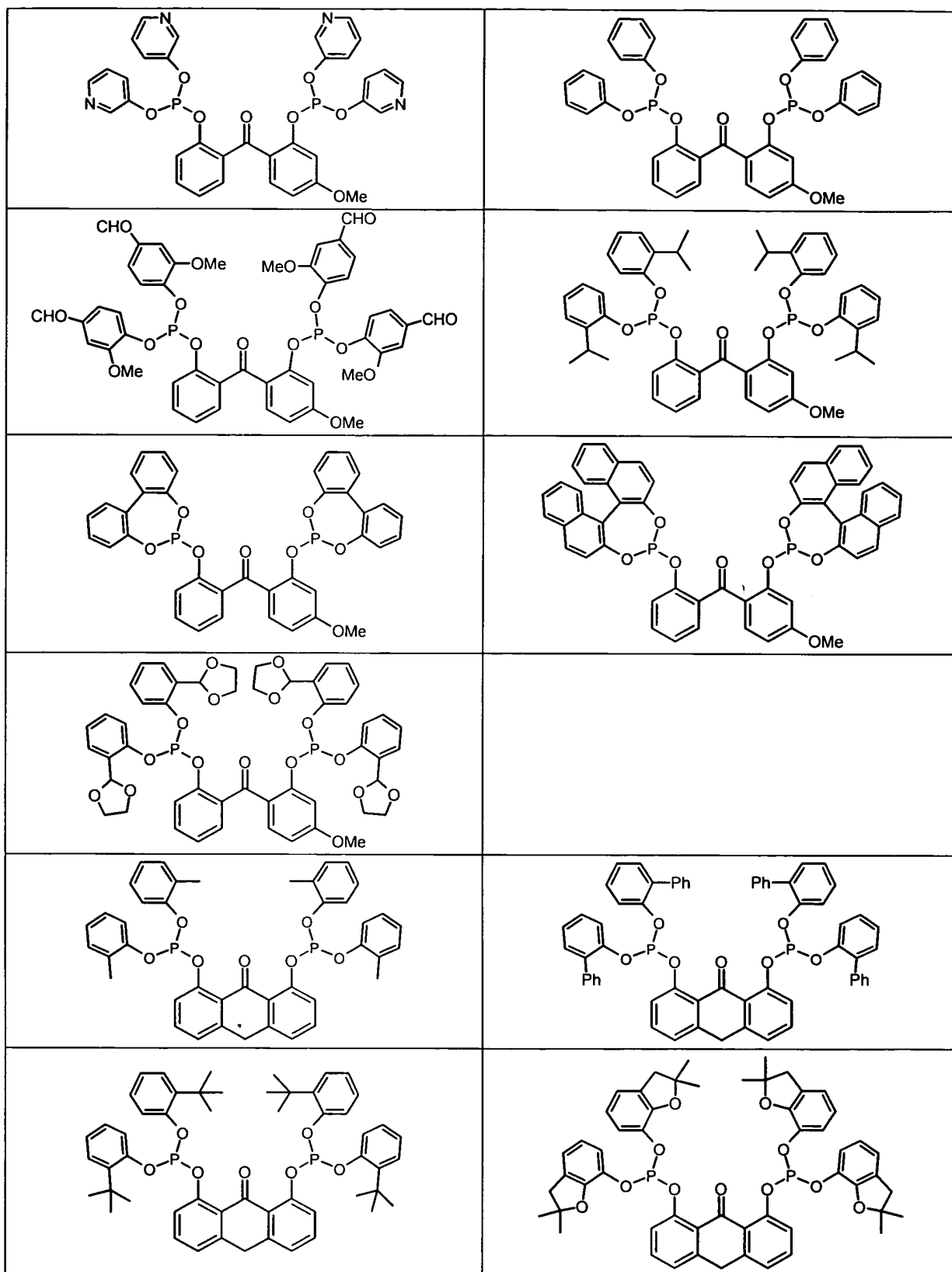


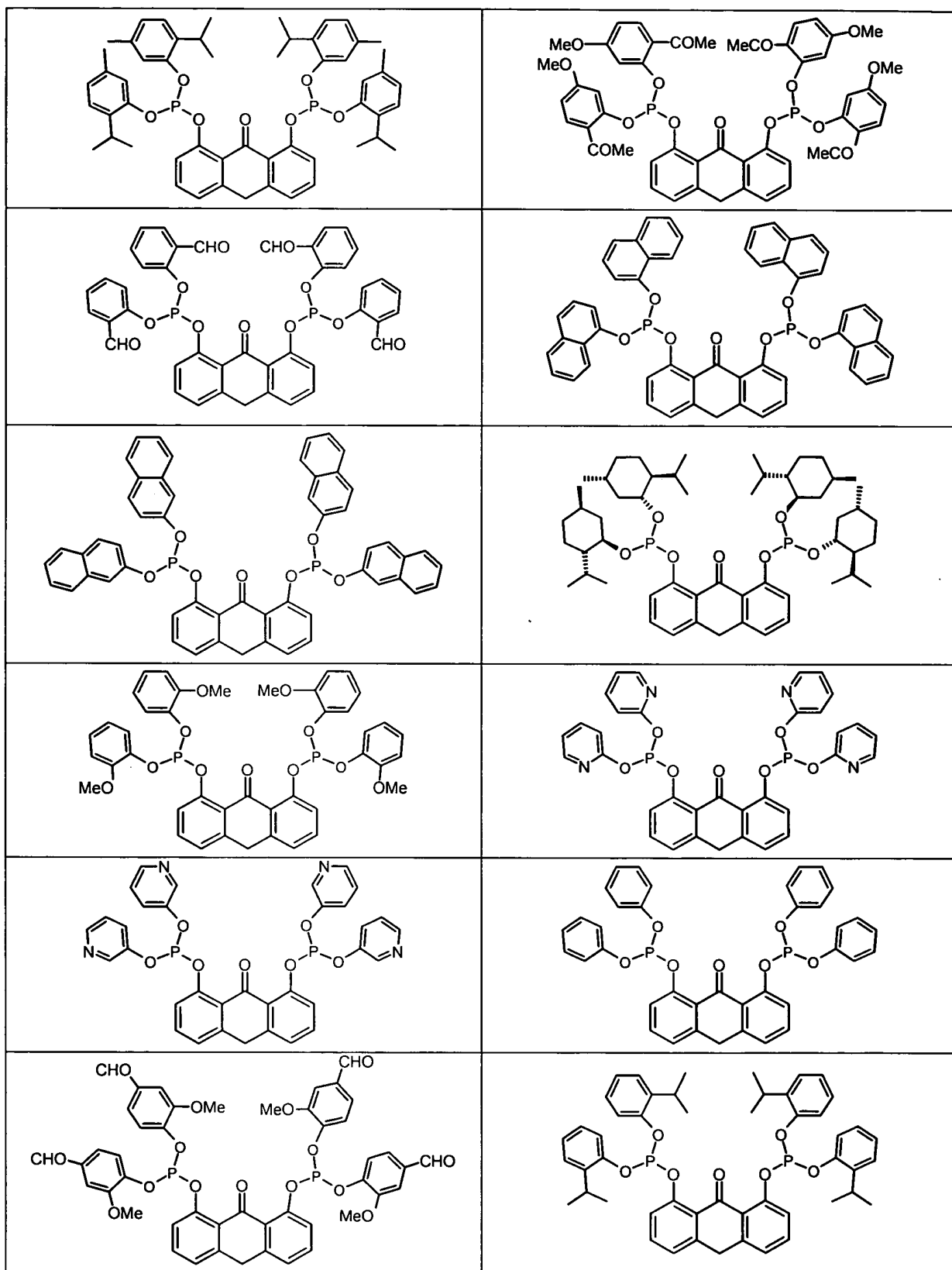


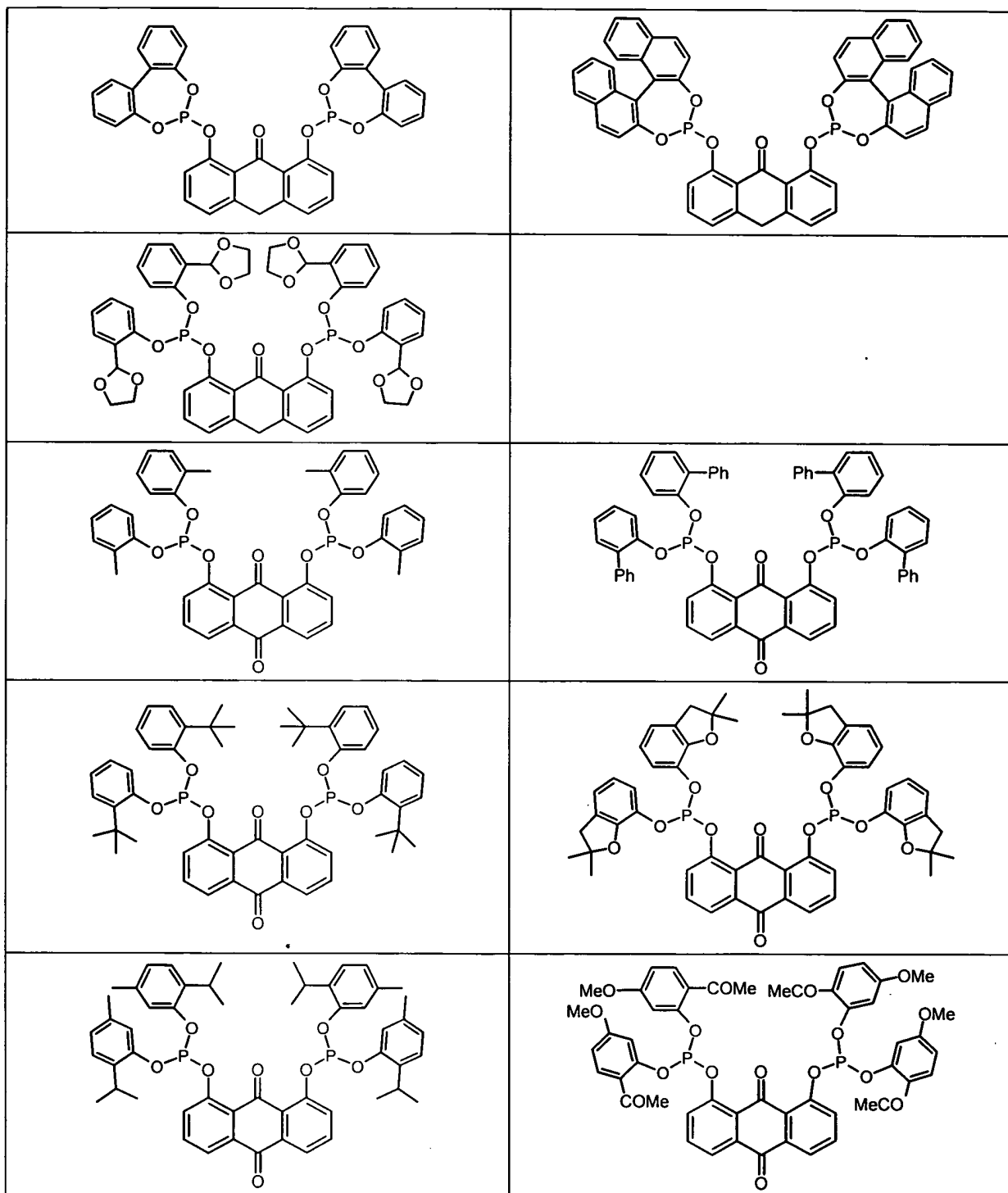


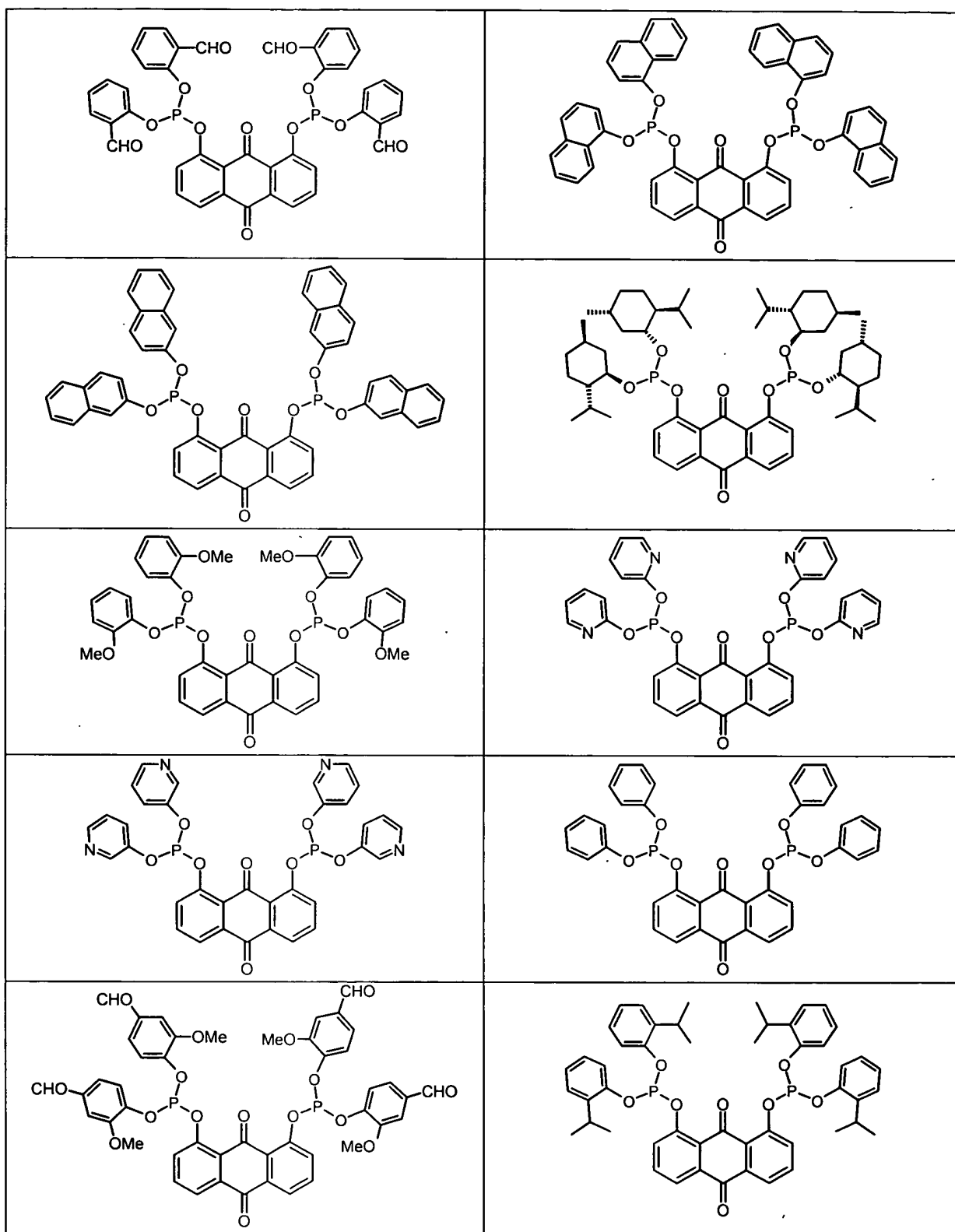


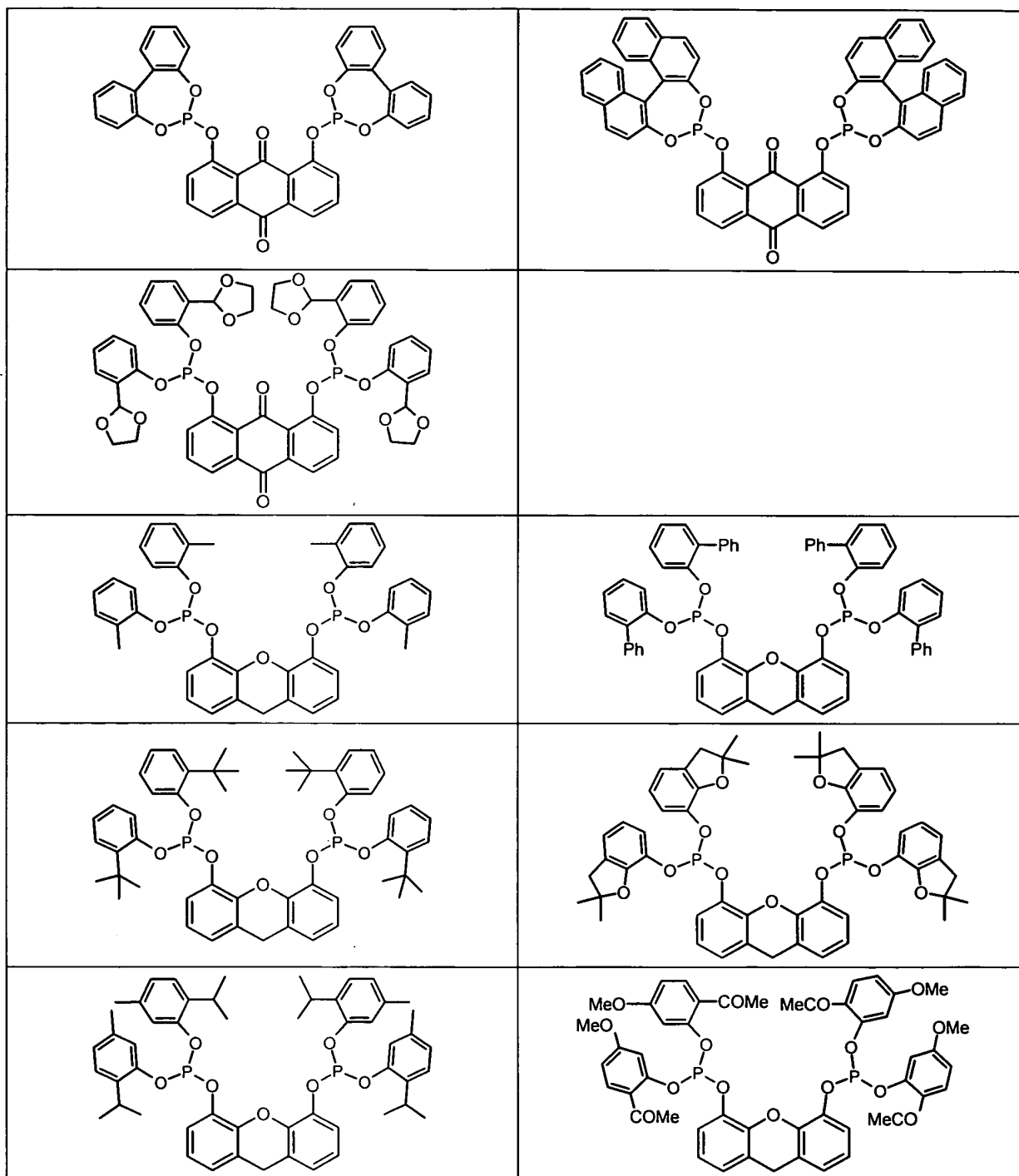


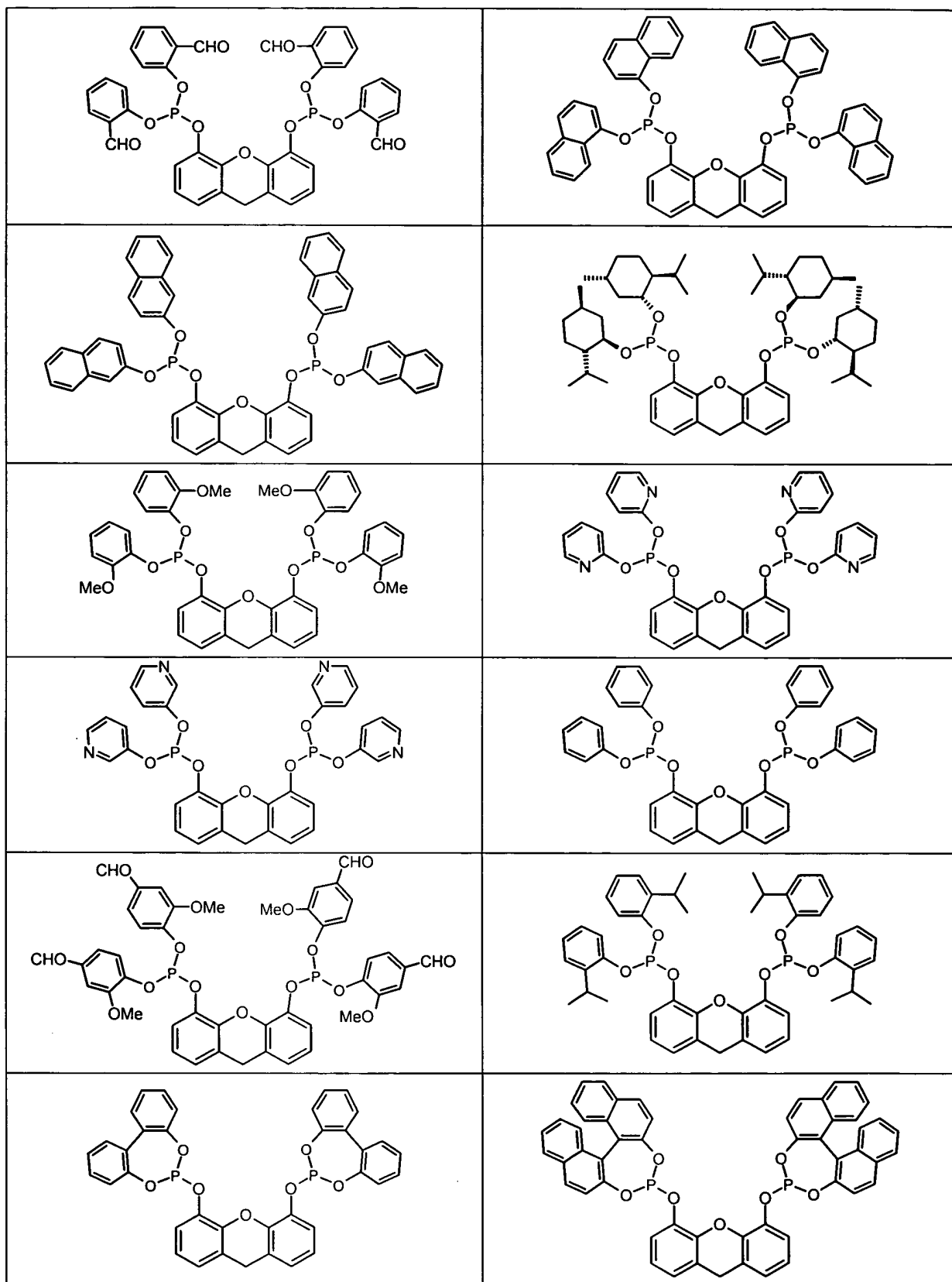


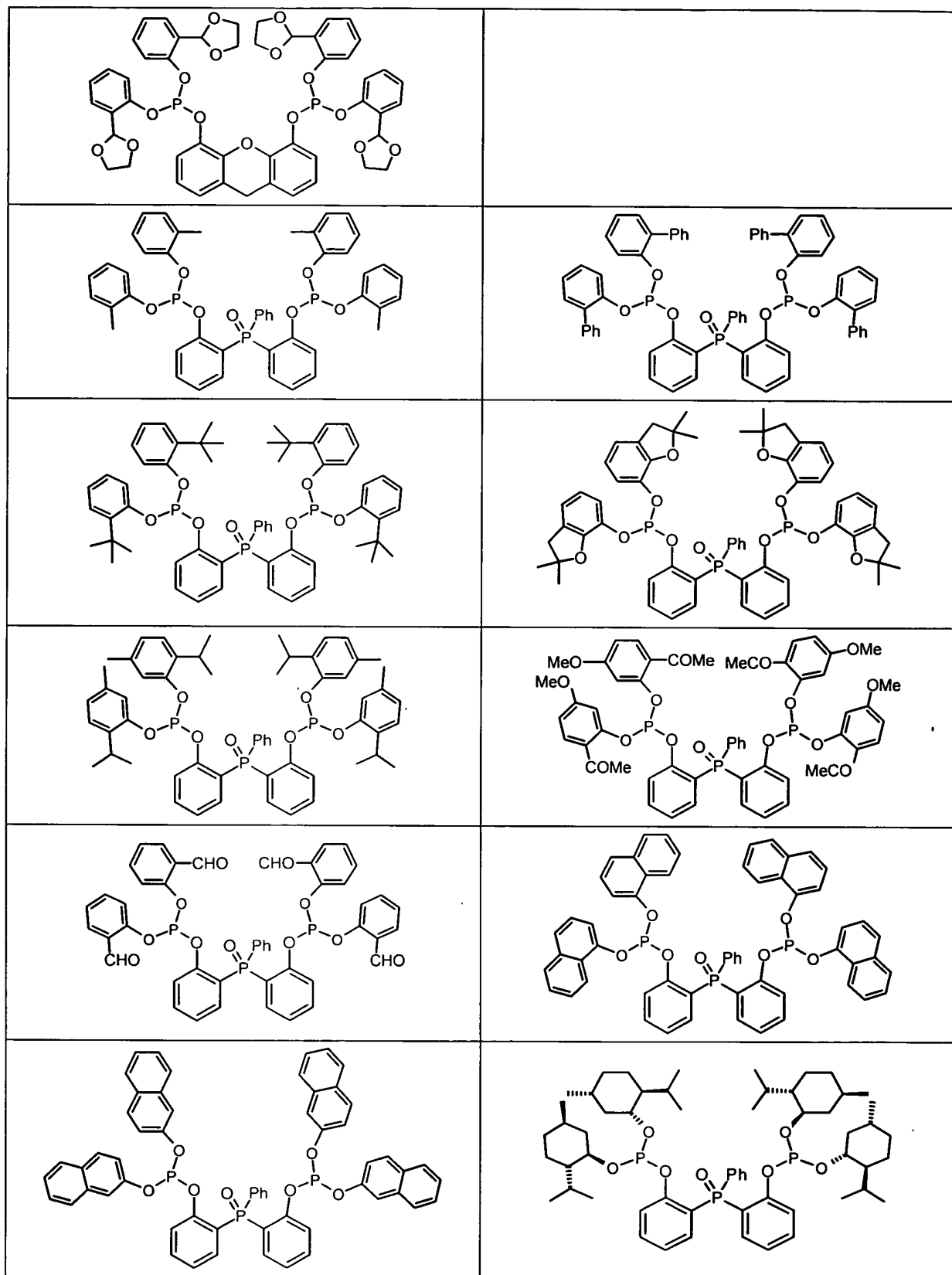


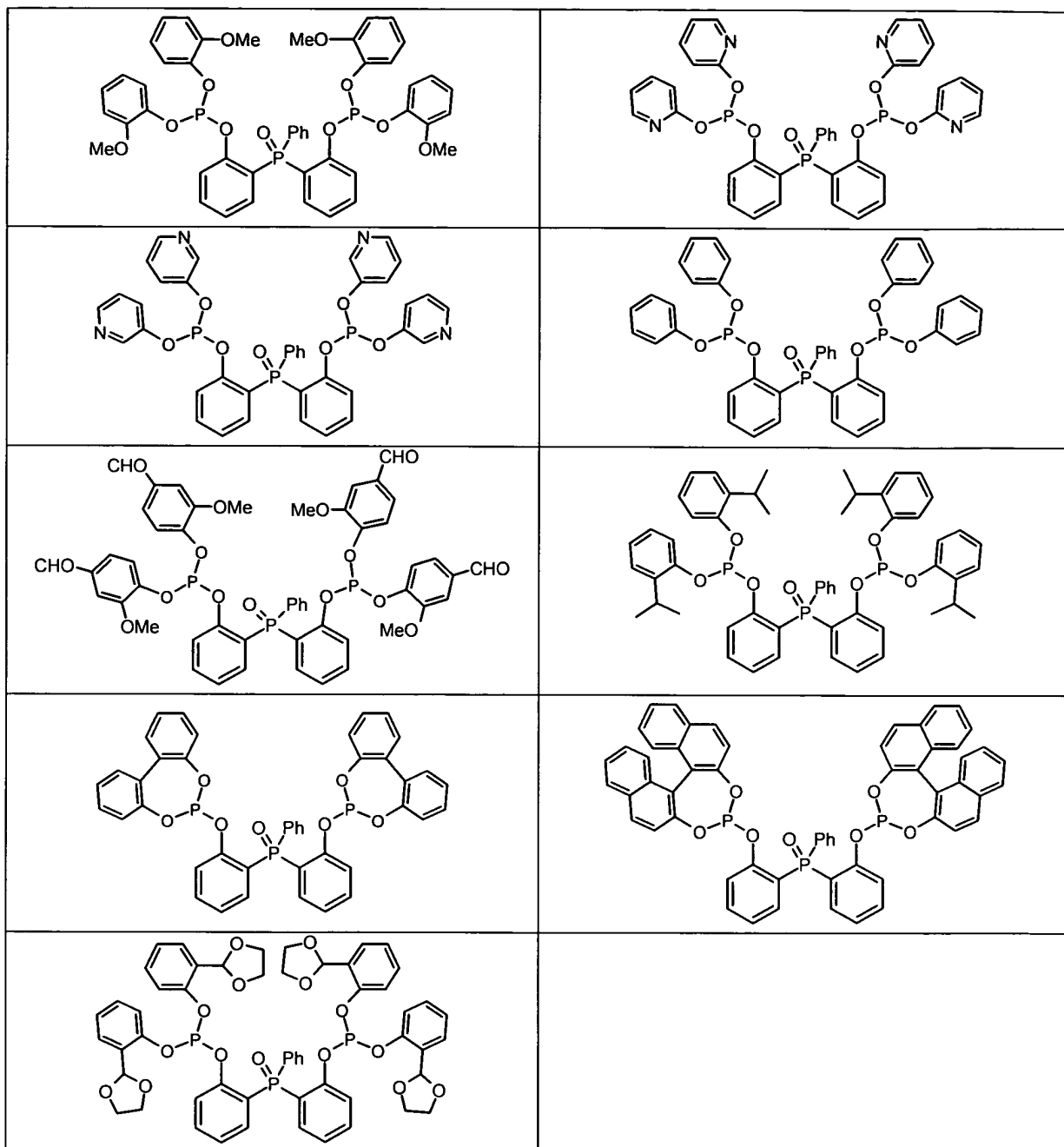












28. (New) The process according to Claim 25, wherein the metallic element is selected from the group consisting of nickel, cobalt, iron, ruthenium, rhodium, palladium, osmium, iridium, platinum, copper, silver, gold, zinc, cadmium and mercury.

29. (New) The process according to Claim 25, wherein the reaction is carried out in a single-phase medium.

30. (New) The process according to Claim 25, wherein the catalyst corresponds to the general formula (II):



in which

M is a transition metal,

L_f represents the organic ligand of formula (I) and

t represents a number between 1 and 4 (inclusive).

31. (New) The process according to Claim 25, wherein the liquid medium further comprises a solvent for the catalyst which is miscible with a phase comprising the compound to be hydrocyanated at the hydrocyanation temperature.

32. (New) The process according to Claim 25, wherein the transition metal compounds are nickel compounds in which nickel is in oxidation state zero, nickel carboxylates, carbonate, bicarbonate, borate, bromide, chloride, citrate, thiocyanate, cyanide, formate, hydroxide, hydrophosphite, phosphite, phosphate and derivatives, iodide, nitrate, sulphate, sulphite, arylsulphonates or alkylsulphonates.

33. (New) The process according to Claim 25, wherein the hydrocarbon compound containing at least one ethylenic unsaturation is a diolefin, ethylenically unsaturated aliphatic nitrile, linear pentenenitrile, or monoolefin .

34. (New) The process according to Claim 25, wherein the transition metal is used in a amount of between 10^{-4} and 1 mol of transition metal per mole of hydrocarbon

compound and wherein the organic ligand of formula (I) is used in a number of moles of from 0.5 to 50 relative to 1 mol of transition metal.

35. (New) The process according to Claim 25, wherein the hydrocyanation reaction is carried out at a temperature from 10°C to 200°C.

36. (New) The process according to Claim 25 for hydrocyanating ethylenically unsaturated nitrile compounds to dinitriles, being operated in the presence of a catalyst system comprising at least one transition metal compound, at least one organic compound of formula (I) and a cocatalyst composed of at least one Lewis acid.

37. (New) The process according to Claim 36, wherein the ethylenically unsaturated nitrile compounds are pent-3-enenitrile, pent-4-enenitrile or mixtures thereof.

38. (New) The process according to Claim 37, wherein the linear pentenenitriles contain amounts of other compounds selected from the group consisting of 2-methylbut-3-enenitrile, 2-methylbut-2-enenitrile, pent-2-enenitrile, valeronitrile, adiponitrile, 2-methylglutaronitrile, 2-ethylsuccinonitrile and butadiene.

39. (New) The process according to Claim 36, wherein the Lewis acid is selected from compounds of the elements of groups Ib, IIb, IIIa, IIIb, IVa, IVb, Va, Vb, VIb, VIIb and VIII of the Periodic Table of the Elements.

40. (New) The process according to Claim 36, wherein the Lewis acid is selected from salts selected from the group of halides, sulphates, sulphonates, haloalkylsulphonates, perhaloalkylsulphonates, haloalkylacetates, perhaloalkylacetates, carboxylates and phosphates.

41. (New) The process according to Claim 36, wherein the Lewis acid is zinc chloride, zinc bromide, zinc iodide, manganese chloride, manganese bromide, cadmium chloride, cadmium bromide, stannous chloride, stannous bromide, stannous sulphate, stannous tartrate, indium trifluoromethylsulphonate, indium trifluoroacetate, zinc trifluoroacetate, lanthanum chloride, cerium chloride, praseodymium chloride, neodymium chloride, samarium chloride, europium chloride, gadolinium chloride, terbium chloride, dysprosium chloride, hafnium chloride, erbium chloride, thallium chloride, ytterbium chloride, lutetium chloride, lanthanum bromide, cerium bromide, praseodymium bromide, neodymium bromide, samarium bromide, europium bromide, gadolinium bromide, terbium bromide, dysprosium bromide, hafnium bromide, erbium bromide, thallium bromide, ytterbium bromide, lutetium bromide, cobalt chloride, ferrous chloride, or yttrium chloride.

42. (New) The process according to Claim 36, wherein the Lewis acid employed represents from 0.01 to 50 mol per mole of transition metal compound.

43. (New) The process according to Claim 36, wherein 2-methylbut-3-enenitrile, present in the reaction mixture originating from butadiene hydrocyanation, is isomerized to pentenenitriles in the absence of hydrogen cyanide, in the presence of a catalyst comprising at least one organic ligand of general formula (I) and at least one transition metal compound.

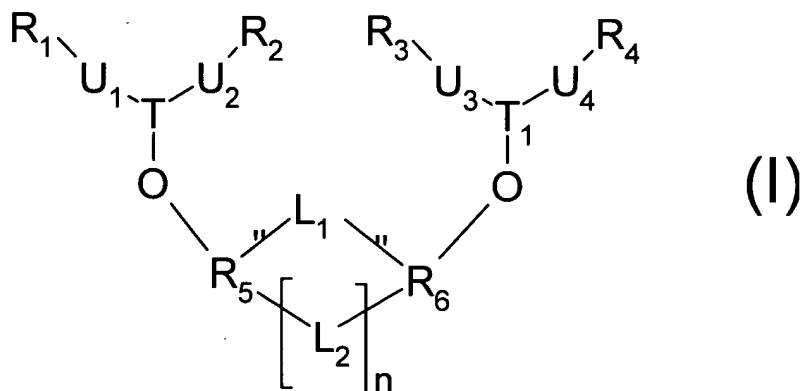
44. (New) The process according to Claim 43, wherein the 2-methylbut-3-enenitrile subjected to isomerization is employed alone or in a mixture with 2-methylbut-2-enenitrile, pent-4-enenitrile, pent-3-enenitrile, pent-2-enenitrile,

butadiene, adiponitrile, 2-methylglutaronitrile, 2-ethylsuccinonitrile or valeronitrile.

45. (New) The process according to Claim 43, wherein the isomerization reaction is carried out at a temperature from 10°C to 200°C.

46. (New) The process according to Claim 43, wherein the isomerization of 2-methylbut-3-enenitrile to pentenenitriles is carried out in the presence of at least one transition metal compound, at least one organic phosphorous ligand of the formula (I) and a cocatalyst composed of at least one Lewis acid.

47. (New) Organophosphorus compounds corresponding to the general formula I below:



in which:

T and T₁, which are identical or different, represent a phosphorus, arsenic or antimony atom,

R₁, R₂, R₃ and R₄, which are identical or different, represent a substituted or unsubstituted, aromatic, aliphatic or cycloaliphatic radical having one or more rings, which are in fused form or not and optionally contain one or more heteroatoms,

wherein the radicals R_1 and R_2 on the one hand and R_3 and R_4 on the other hand optionally be interconnected by a covalent bond, a hydrocarbon chain or a heteroatom, U_1 , U_2 , U_3 and U_4 , which are identical or different, represent an oxygen atom or a radical of formula NR in which R denotes a monovalent alkyl, aryl, cycloalkyl, sulphonyl or carbonyl radical,

R_5 and R_6 , which are identical or different, represent an aryl or cycloaliphatic group optionally comprise heteroatoms and/or one or more rings, in fused form or not, and which are substituted or unsubstituted,

n is an integer equal to 0 or 1,

L_1 , when n is 0, represents a divalent radical selected from the group consisting of the groups NR_7 , PR_8 , SiR_9R_{10} , BR_{11} , S , POR_{12} , SO_2 and CO , in which R_7 is as defined for R above, R_8 and R_{12} may represent the radical OR_{13} , and R_8 , R_9 , R_{10} , R_{11} , R_{12} and R_{13} represent alkyl, aryl or cycloalkyl radicals,

L_1 and L_2 , when n is 1, are identical or different and represent a covalent bond or a radical selected from the group consisting of the groups O , NR_7 , PR_8 , SiR_9R_{10} , BR_{11} , S , POR_{12} , SO_2 , CO and $-CR_{14}R_{15}-$, in which R_7 is as defined for R above, R_8 and R_{12} optionally represent the radical OR_{13} , and R_8 , R_9 , R_{10} , R_{11} , R_{12} , R_{13} , R_{14} and R_{15} represent alkyl, aryl or cycloalkyl radicals, it being possible also for R_{14} and R_{15} to represent a hydrogen atom.

48. (New) Organophosphorus compounds, corresponding to the formulae below:

